Appl. No. 10/720,311
Examiner: CHEN, KIN-CHAN, Art Unit 1765
In response to the Office Action dated January 5, 2006

Date: April 5, 2006
Attorney Docket No. 10113261

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claim 1 (Previously Presented): A method for forming a bottle-shaped trench, comprising:

providing a semiconductor substrate with a trench having a pad stack layer thereon;

filling a mask layer into the lower portion of the trench;

plasma nitriding a sidewall of the trench of the substrate using the mask layer as a mask to form a sidewall nitride layer on the trench sidewall;

removing the mask layer; and

etching the lower portion of the trench to form a bottle-shaped trench using the sidewall nitride layer as a mask.

Claim 2 (Original): The method as claimed in claim 1, wherein the pad stack layer comprises an oxide layer and a nitride layer.

Claim 3 (Original): The method as claimed in claim 1, wherein the mask layer is a photoresist material.

Claim 4 (Original): The method as claimed in claim 1, wherein the plasma nitridation temperature is 25~100°C.

Claim 5 (Original): The method as claimed in claim 1, wherein the lower portion of the trench is etched by wet etching.

Claim 6 (Original): The method as claimed in claim 5, wherein the wet etching solution is ammonia ($NH_4OH + H_2O$).

Claim 7 (Original): The method as claimed in claim 1, wherein the plasma nitridation pressure is 30~50Pa.

Claim 8 (Original): The method as claimed in claim 1, wherein the plasma is RF plasma.

Claim 9 (Original): The method as claimed in claim 8, wherein the RF power is 500~1000W.

Claim 10 (Currently Amended): A method for forming a bottle-shaped trench, comprising:

providing a semiconductor substrate with a trench having a pad stack layer thereon;

filling a photoresist layer into the lower portion of the trench;

plasma nitriding a sidewall of the trench of the substrate to form a sidewall nitride layer on the pad stack layer and the upper portion of the trench sidewall not covered by the photoresist layer, wherein the plasma nitriding step has a process temperature of about 25~100°C;

after forming the sidewall nitride layer, removing the photoresist layer; and

etching the lower portion of the trench to form a bottle-shaped trench.

Claim 11 (Original): The method as claimed in claim 10, wherein the lower portion of the trench etching is wet etching.

Claim 12 (Original): The method as claimed in claim 11, wherein the wet etching solution is ammonia ($NH_4OH + H_2O$).

Claim 13 (Previously Presented): The method as claimed in claim 10, wherein the plasma nitridation pressure is 30~50Pa.

Claim 14 (Original): The method as claimed in claim 10, wherein the plasma is RF plasma.

Claim 15 (Original): The method as claimed in claim 14, wherein the RF power is 500~1000W.

Claim 16 (Original): A method for forming a bottle-shaped trench, comprising:

providing a semiconductor substrate with a trench having a pad oxide layer and a nitride layer thereon;

filling a mask layer into the lower portion of the trench;

etching a portion of the pad oxide layer near the trench to reveal a corner of the substrate;

using plasma nitridation to form a sidewall nitride layer on the trench sidewall and to fill the pad oxide recess;

removing the mask layer; and

etching the lower portion of the trench to form a bottle-shaped trench.

Claim 17 (Original): The method as claimed in claim 16, wherein the mask layer is photoresist.

Claim 18 (Original): The method as claimed in claim 16, wherein the plasma nitridation temperature is 25~100°C.

Claim 19 (Original): The method as claimed in claim 16, wherein the lower portion of the trench is etched by wet etching.

Claim 20 (Original): The method as claimed in claim 19, wherein the wet etching solution is ammonia ($NH_4OH + H_2O$).

Claim 21 (Previously Presented): The method as claimed in claim 16, wherein the plasma nitridation pressure is 30~50Pa.

Claim 22 (Original): The method as claimed in claim 16, wherein the plasma is RF plasma.

Claim 23 (Original): The method as claimed in claim 22, wherein the RF power is 500~1000W.

Claim 24 (Original): A method for forming a bottle-shaped trench, comprising:

providing a semiconductor substrate with a trench having a pad oxide layer and a nitride layer thereon;

filling a photoresist layer into the lower portion of the trench;

etching a portion of the pad oxide layer near the trench to reveal a corner of the substrate;

using the 25~100°C plasma nitridation to form a sidewall nitride layer on the trench sidewall and to fill the pad oxide recess;

removing the photoresist layer; and

etching the lower portion of the trench to form a bottle-shaped trench.

Claim 25 (Original): The method as claimed in claim 24, wherein the lower portion of the trench is etched by wet etching.

Claim 26 (Original): The method as claimed in claim 25, wherein the wet etching solution is ammonia ($NH_4OH + H_2O$).

Claim 27 (Original): The method as claimed in claim 24, wherein the plasma nitridation pressure is 30~50Pa.

Claim 28 (Original): The method as claimed in claim 24, wherein the plasma is RF plasma.

Claim 29 (Original): The method as claimed in claim 28, wherein the RF power is 500~1000W.